GERB thermal flux regional bias: detection and correction by comparison with CERES

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Overview

- Methodology
- Used data
- Comparison results
- Bias correction
- Conclusions

Methodology

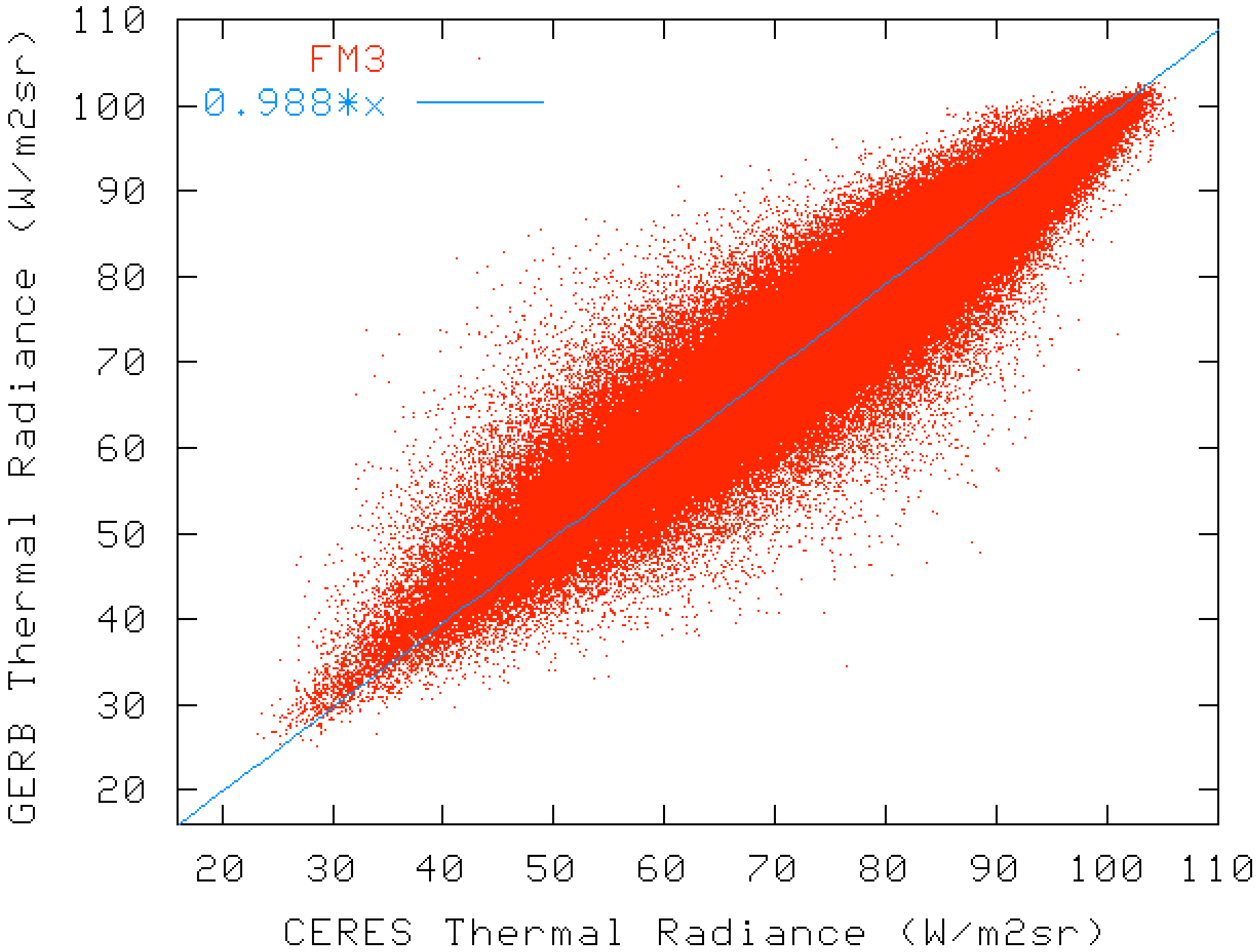
- Radiative flux at the top of the atmosphere: F (W/m^2)
- Satellite observations: radiances L (W/m^2sr)
- Satellite viewing zenith angle θ_{vz}

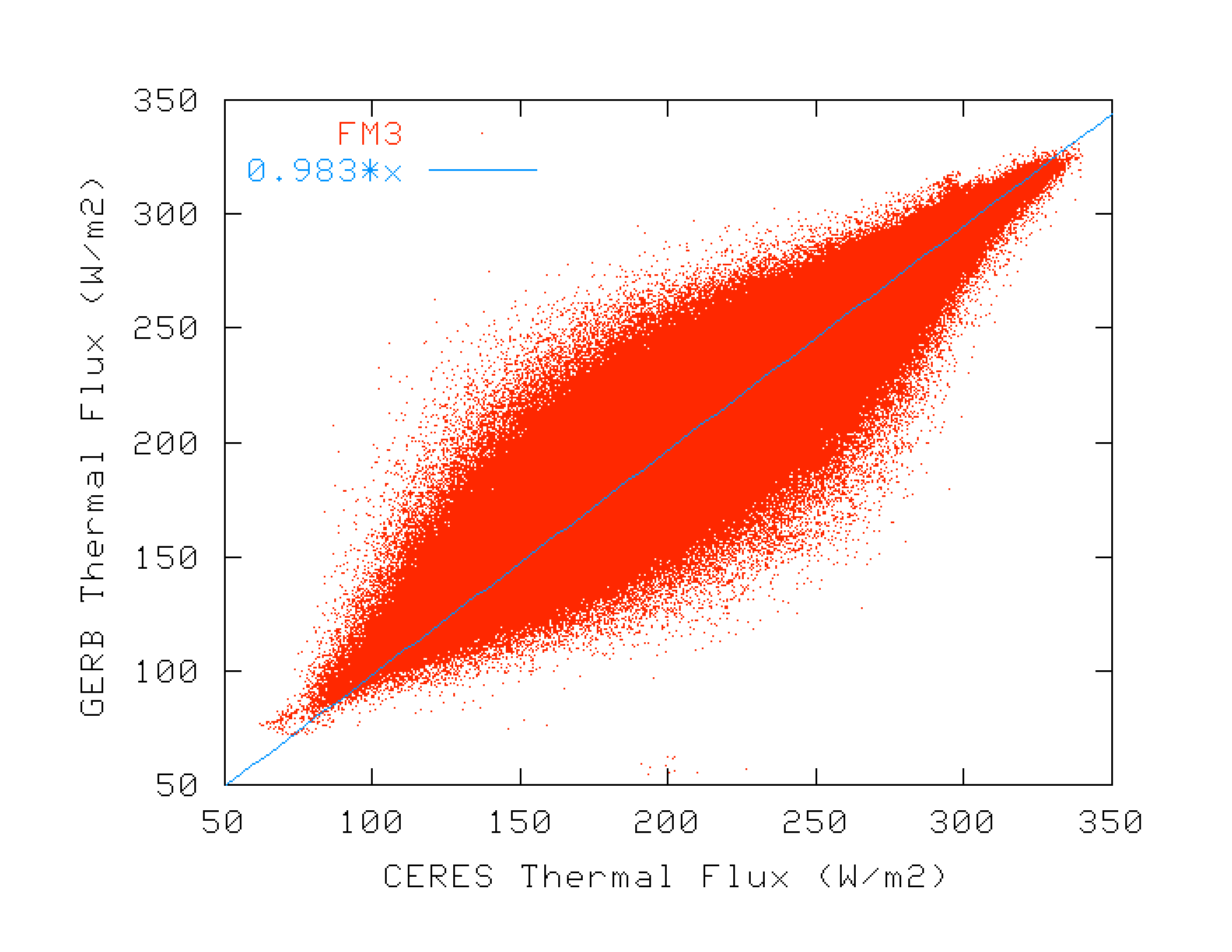
$$F = \pi L(\theta_{vz}) / R(\theta_{vz})$$

- GERB: fixed θ_{vz}
- Validation GERB fluxes: comparison with CERES fluxes with variable θ_{vz}

Used data

- GERB: ARG fluxes, SEVIRI as imager, Version 2
- CERES FM3: RAPS or GERB mode or special scan, ES8, use of inflight calibration
- 1-6/2004
- use of night data for thermal fluxes
- CERES data is colocated to nearest GERB ARG pixel


FM3
0.988*x
GERB Thermal Radiance (W/m2sr)
CERES Thermal Radiance (W/m2sr)
20
30
40
50
60
70
80
90
100
110

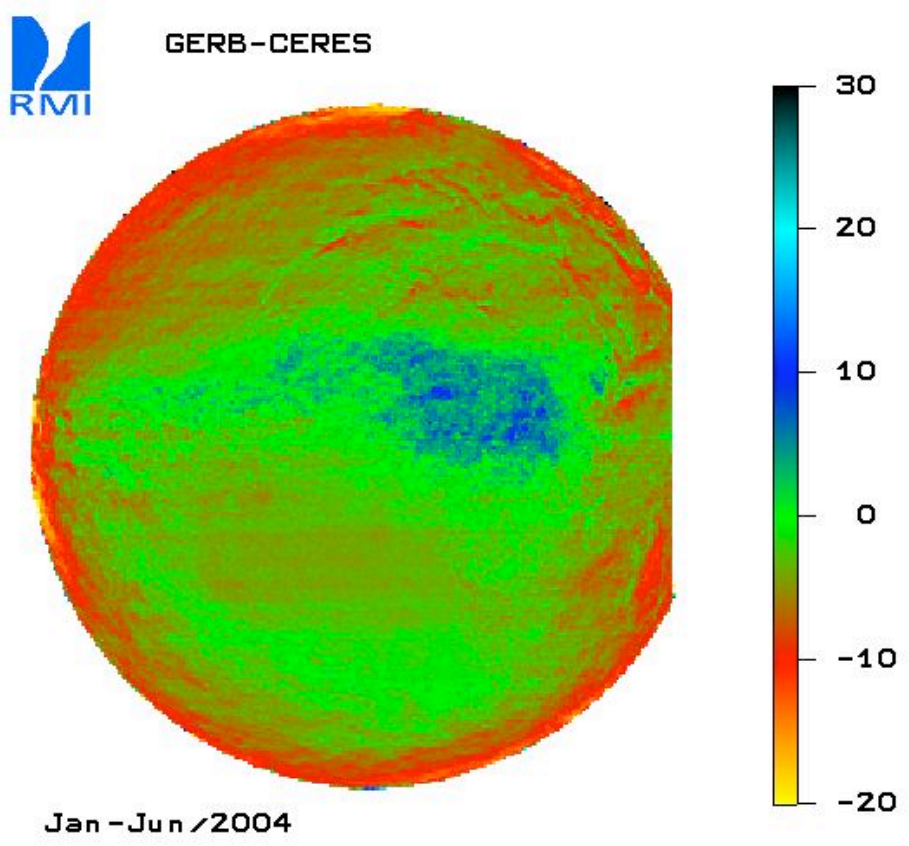

FM3
0.983*x
GERB Thermal Flux (W/m2)
CERES Thermal Flux (W/m2)
50
100
150
200
250
300
350

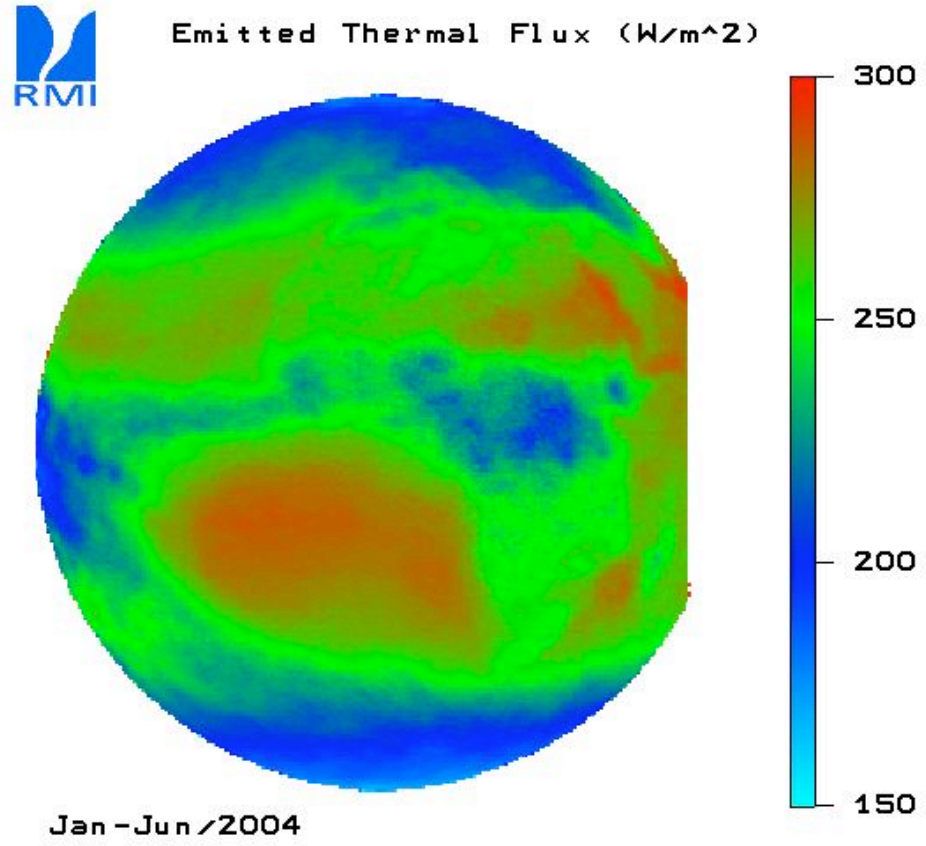
95% confidence intervals

- Radiance
  GERB/(CERES ES8 FM3) = 0.988 +/- 0.002

- Flux
  GERB/(CERES ES8 FM3) = 0.983 +/- 0.002
- (CERES SSF)/(CERES ES8) = 0.992
- GERB/(CERES SSF FM3) = 0.991 +/- 0.002

Regional distribution



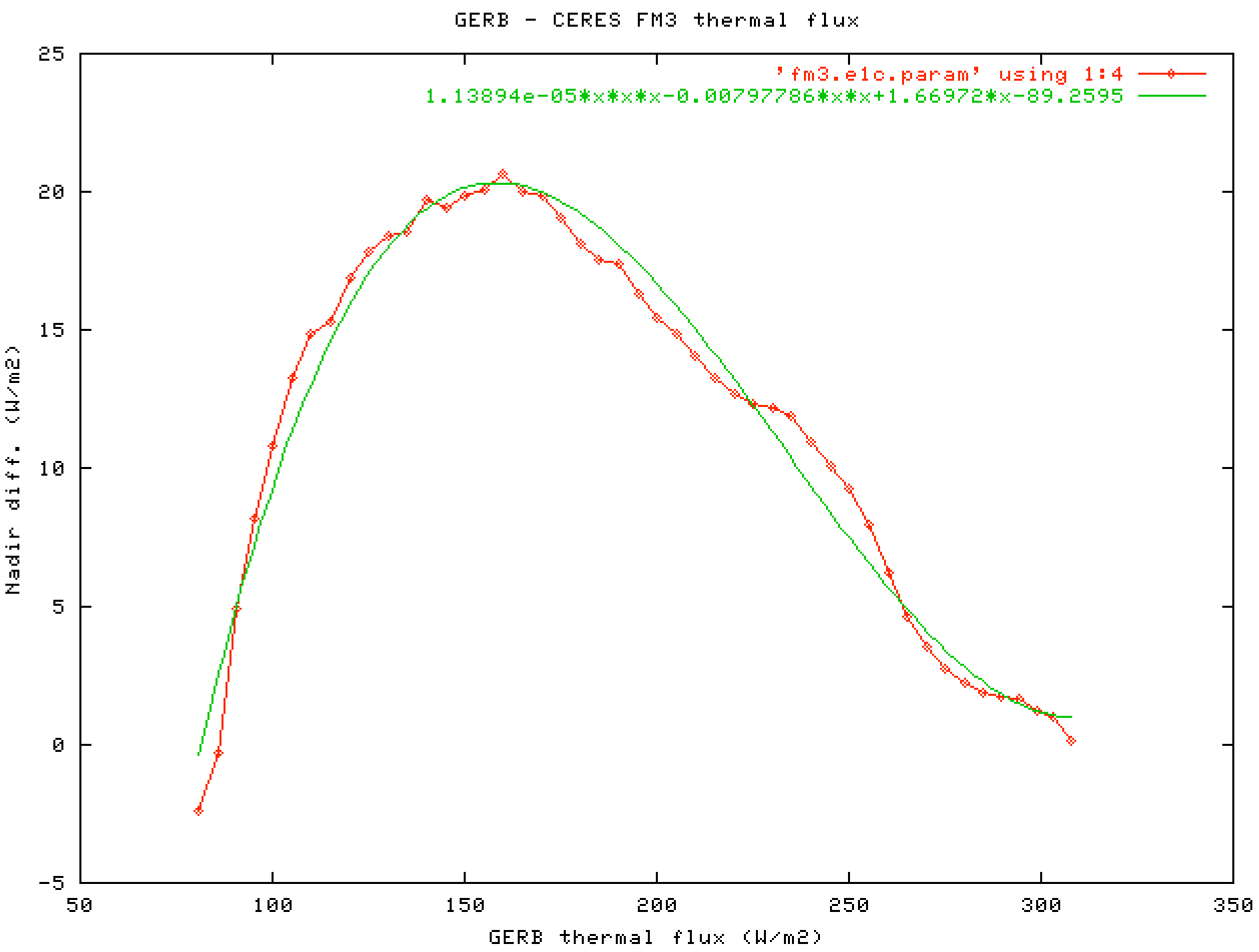


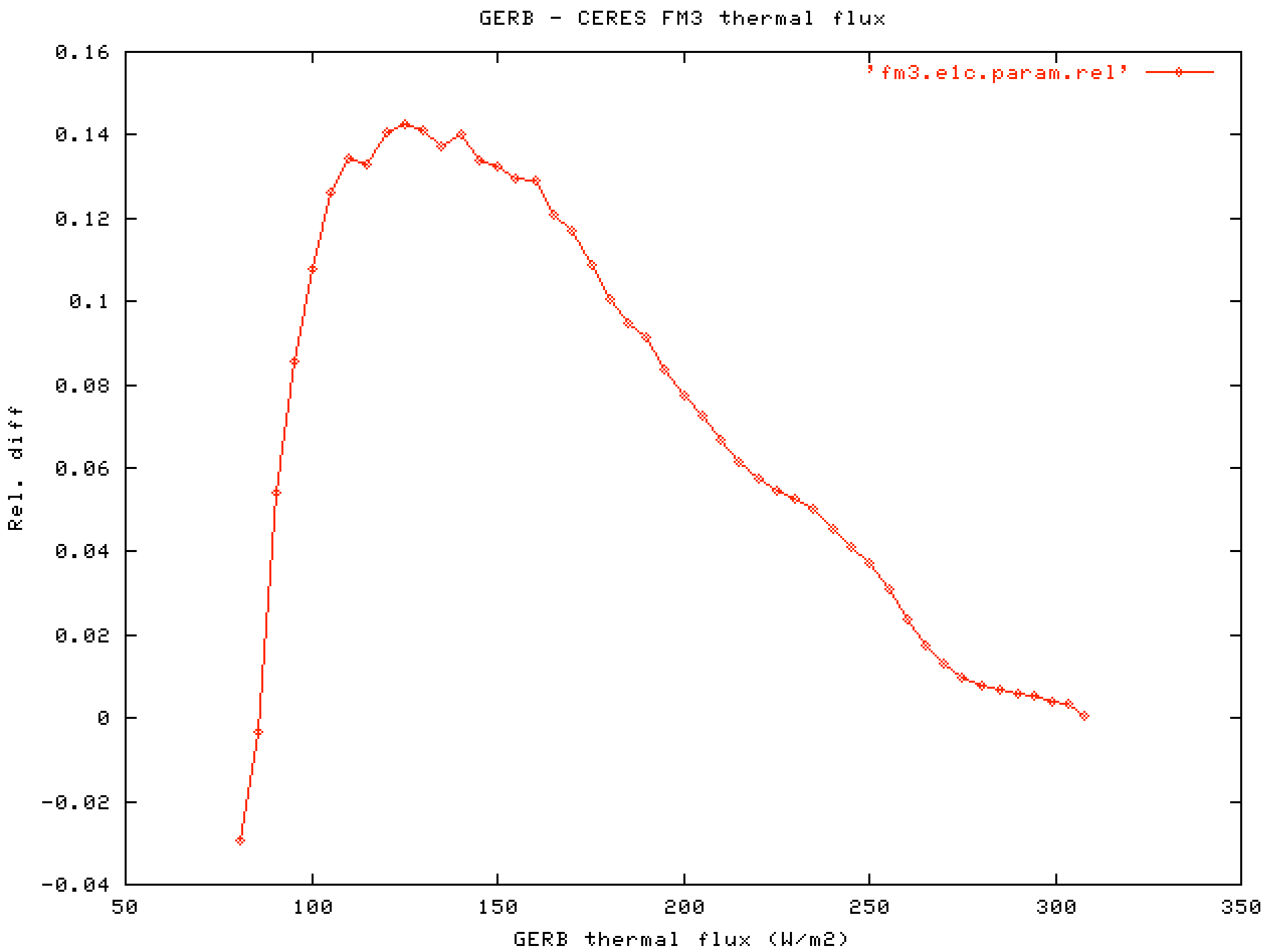
GERB – CERES difference fit

- Impose linear variation with θ_{vz} :
  $f(\theta_{vz})=(52.5°- \theta_{vz})/ 52.5°$
- Fit difference as function of GERB flux:
  $F_{gerb}-F_{ceres}=a(F_{gerb}).\ f(\theta_{vz})+b(F_{gerb})$

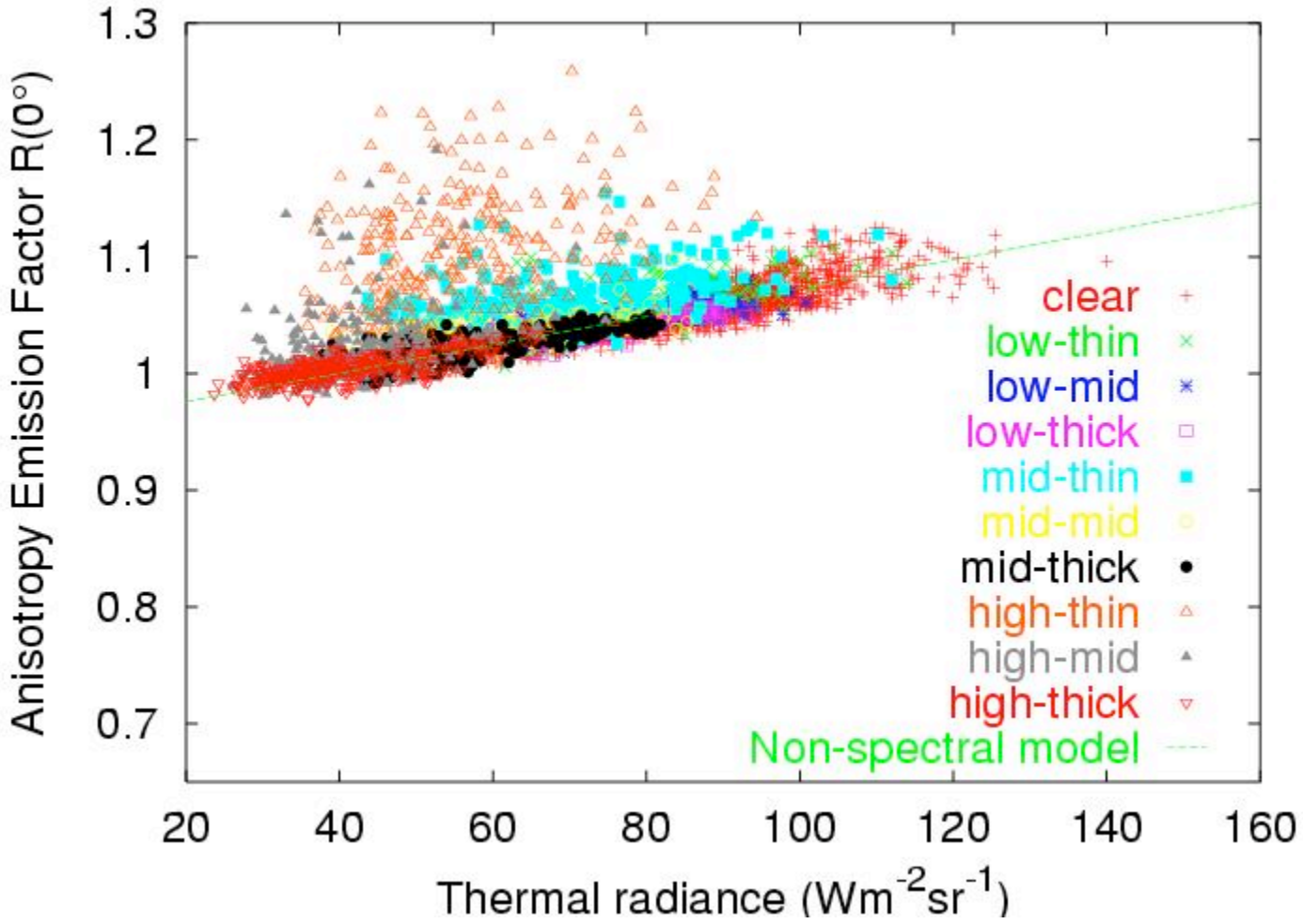
  $a(F_{gerb})$ = GERB nadir error

- Corrected GERB flux = $F_{gerb} - a(F_{gerb}) .\ f(\theta_{vz})$


GERB - CERES FM3 thermal flux
'fm3.elc.param' using 1:4
1.13894e-05*x*x*x-0.00797786*x*x+1.66972*x-89.2595
Nadir diff. (W/m2)
GERB thermal flux (W/m2)
25
20
15
10
5
0
-5
50
100
150
200
250
300
350

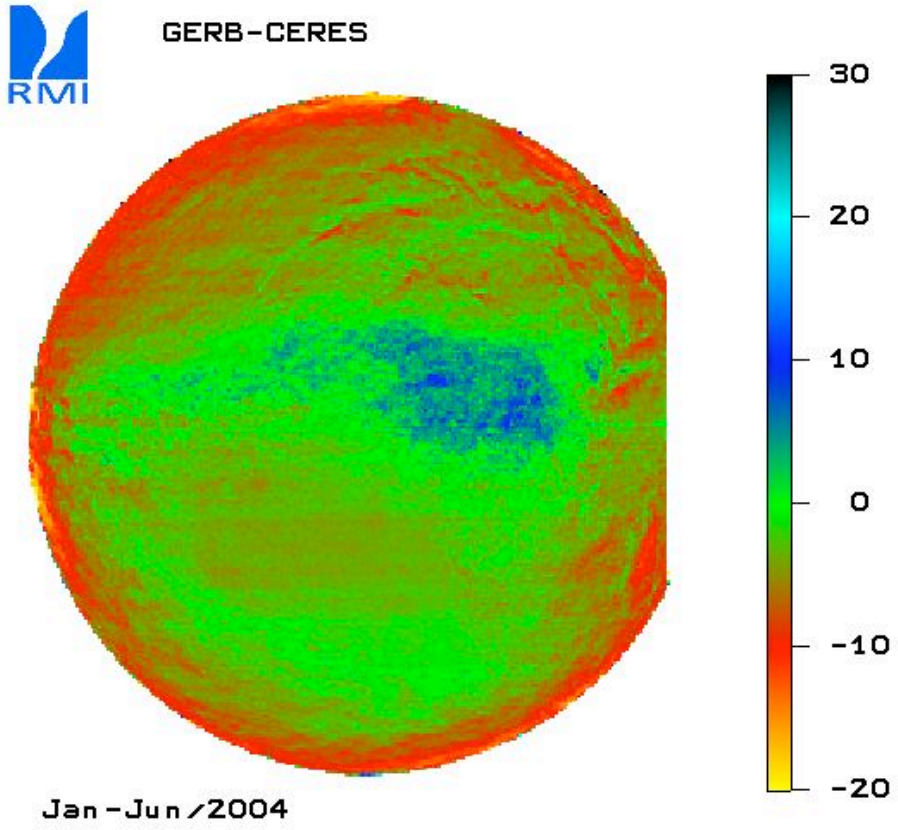

GERB - CERES FM3 thermal flux
'fm3.e1c.param.rel'
Rel. diff
GERB thermal flux (W/m2)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
50
100
150
200
250
300
350

Expected theoretical error

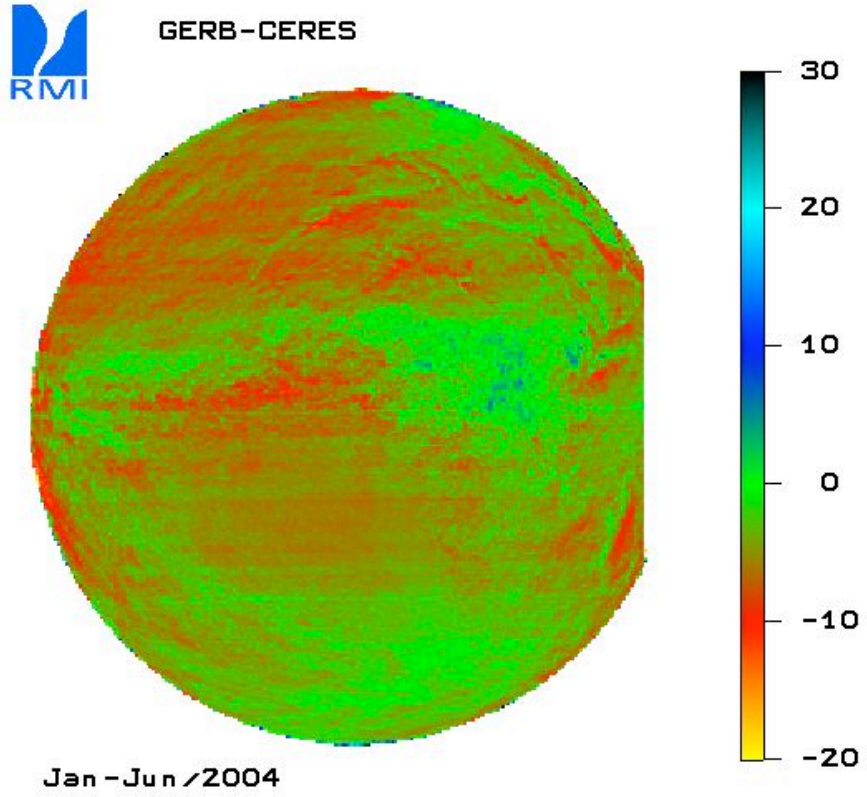


All scenes

Before correction



After correction

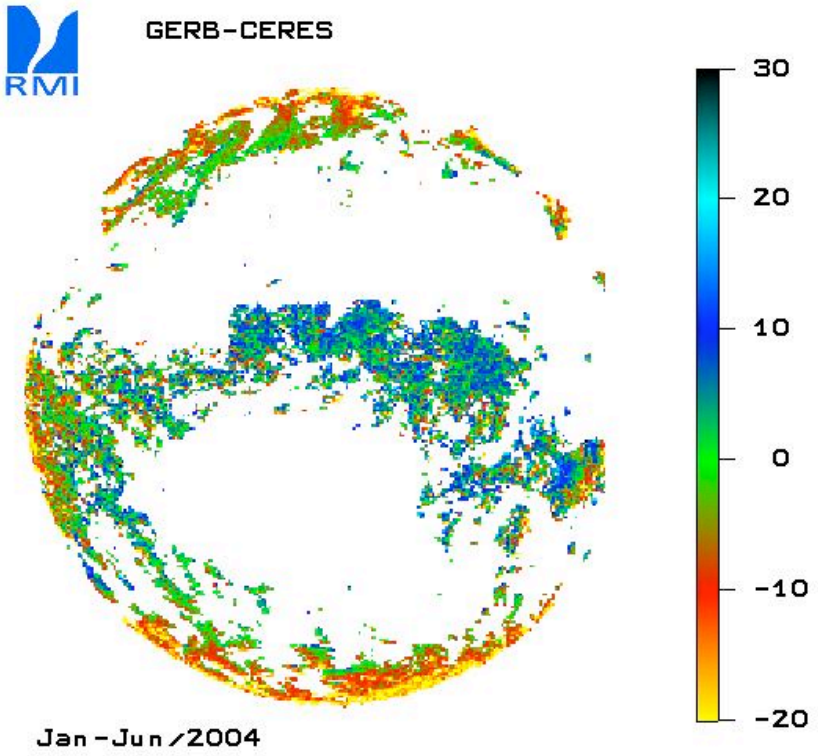


Conclusions

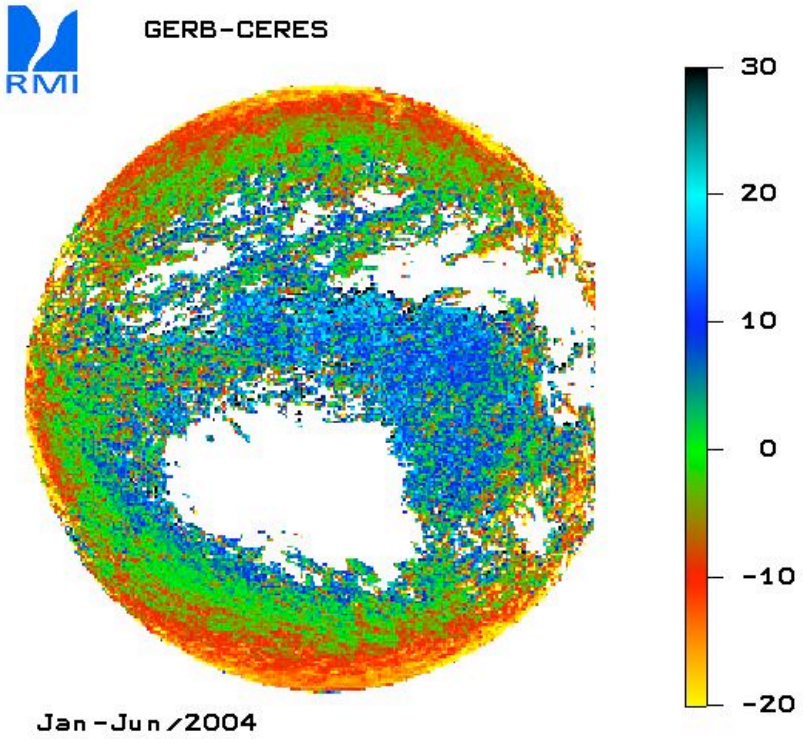
- On the average, the GERB and CERES FM3 thermal fluxes agree within the required 1%.
- The anisotropy of the GERB fluxes is underestimated by the radiative transfer implicit ADM's, resulting in regional biases up to 20 W/m^2.
- The bias seems to be due to semitransparent clouds, but it as a higher amplitude (0.14) than expected.
- An empirical GERB flux correction has been defined, which removes the bias within +/- 5 W/m^2.
- For further improvement of the instantaneous fluxes, a more detailed IR scene identification is needed.

Coldest scenes

Flux < 125 W/m2

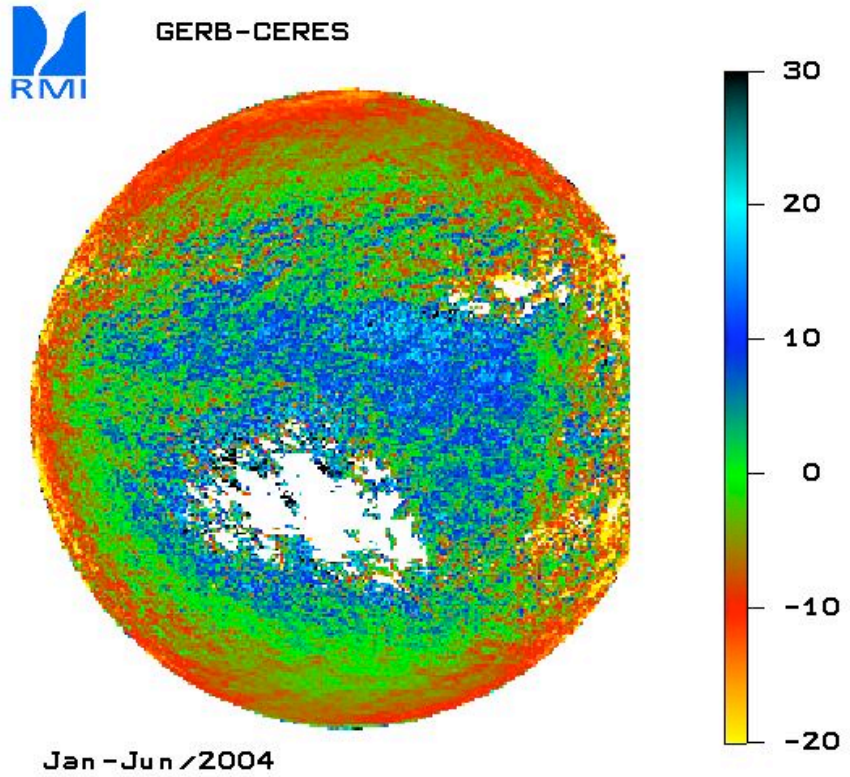


125 W/m2 < Flux < 175 W/m2

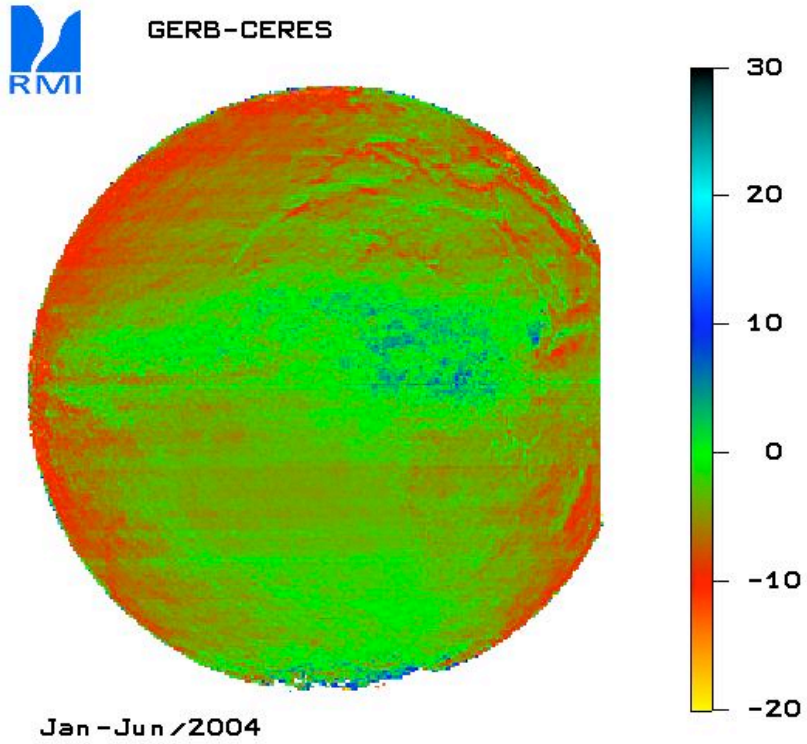


Warmest scenes

175 W/m2 < Flux < 225 W/m2

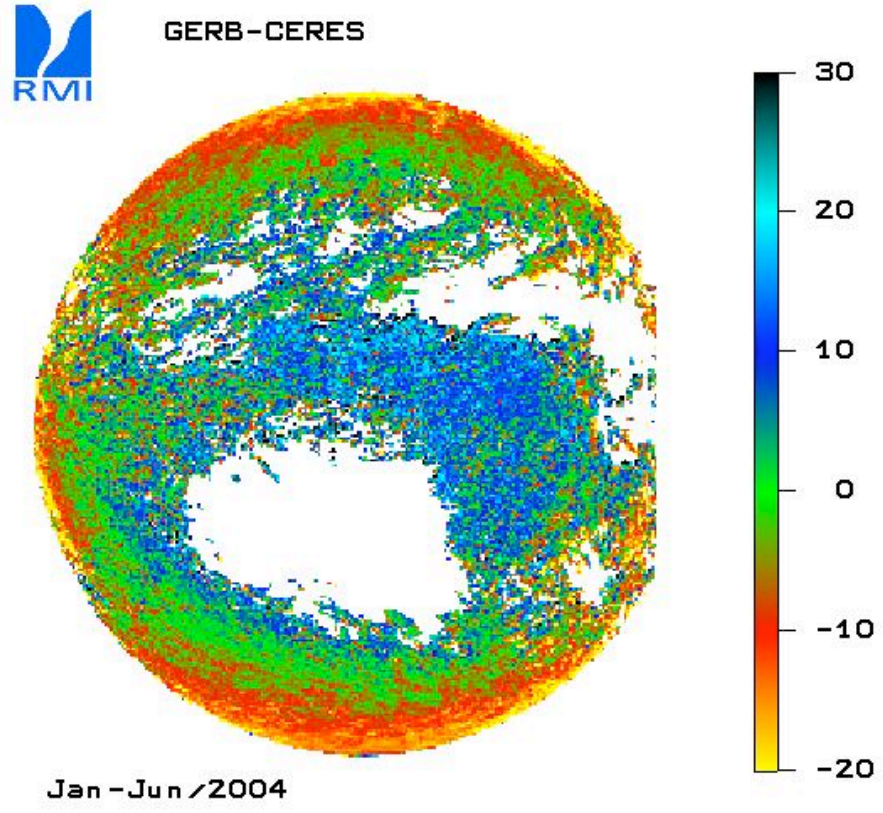


Flux > 225 W/m2

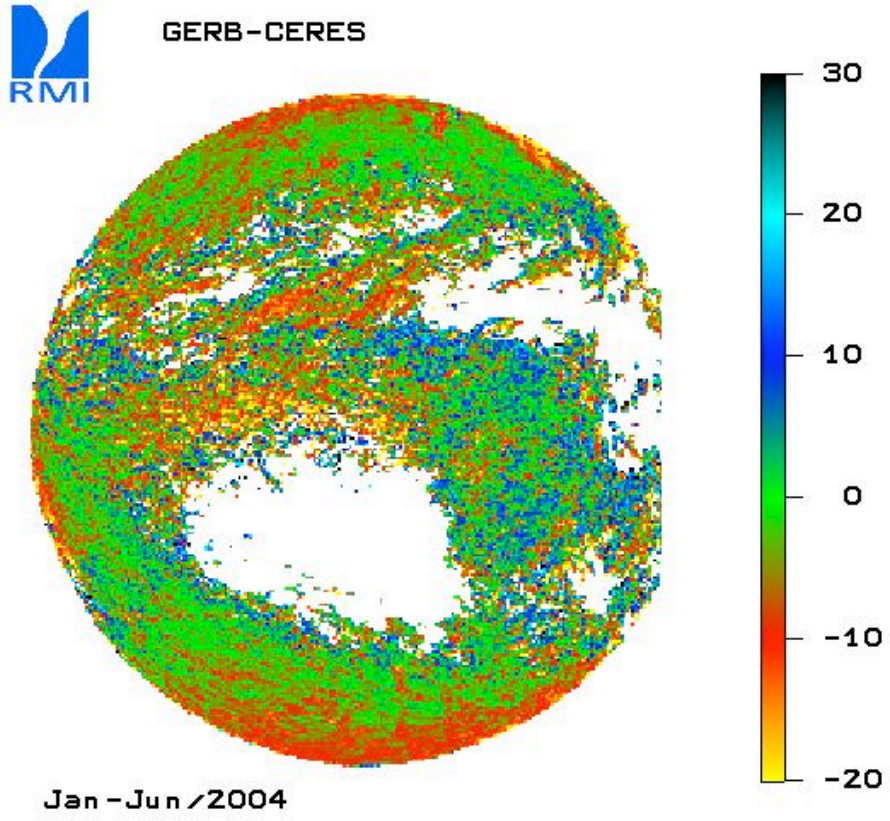


125 W/m2 < flux < 175 W/m2

Before correction

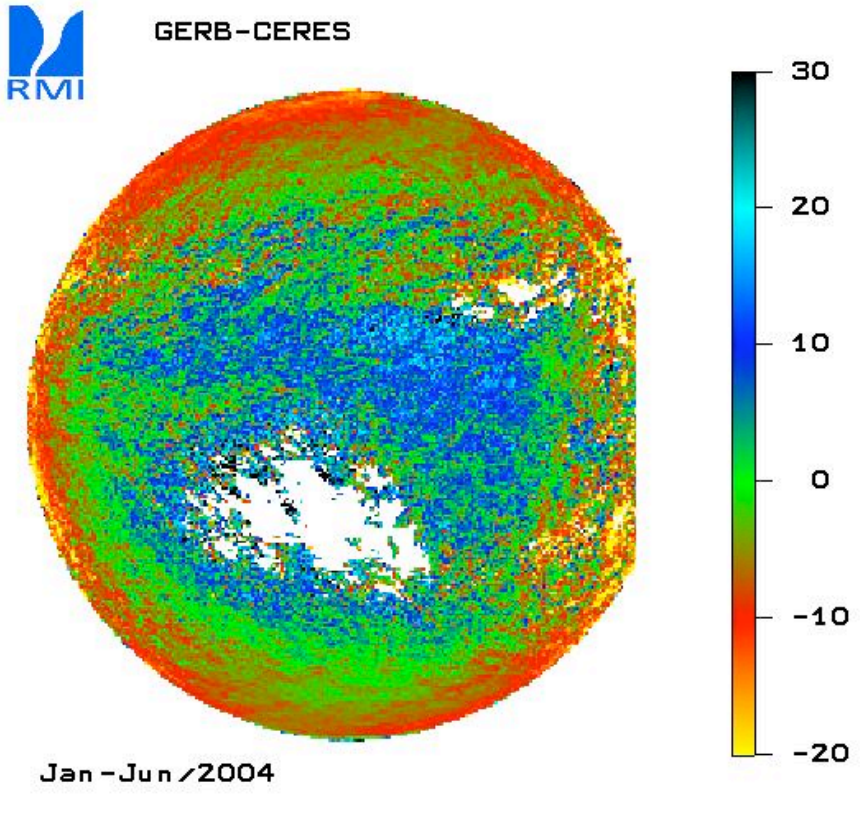


After correction



175 W/m2 < flux < 225 W/m2

Before correction



After correction